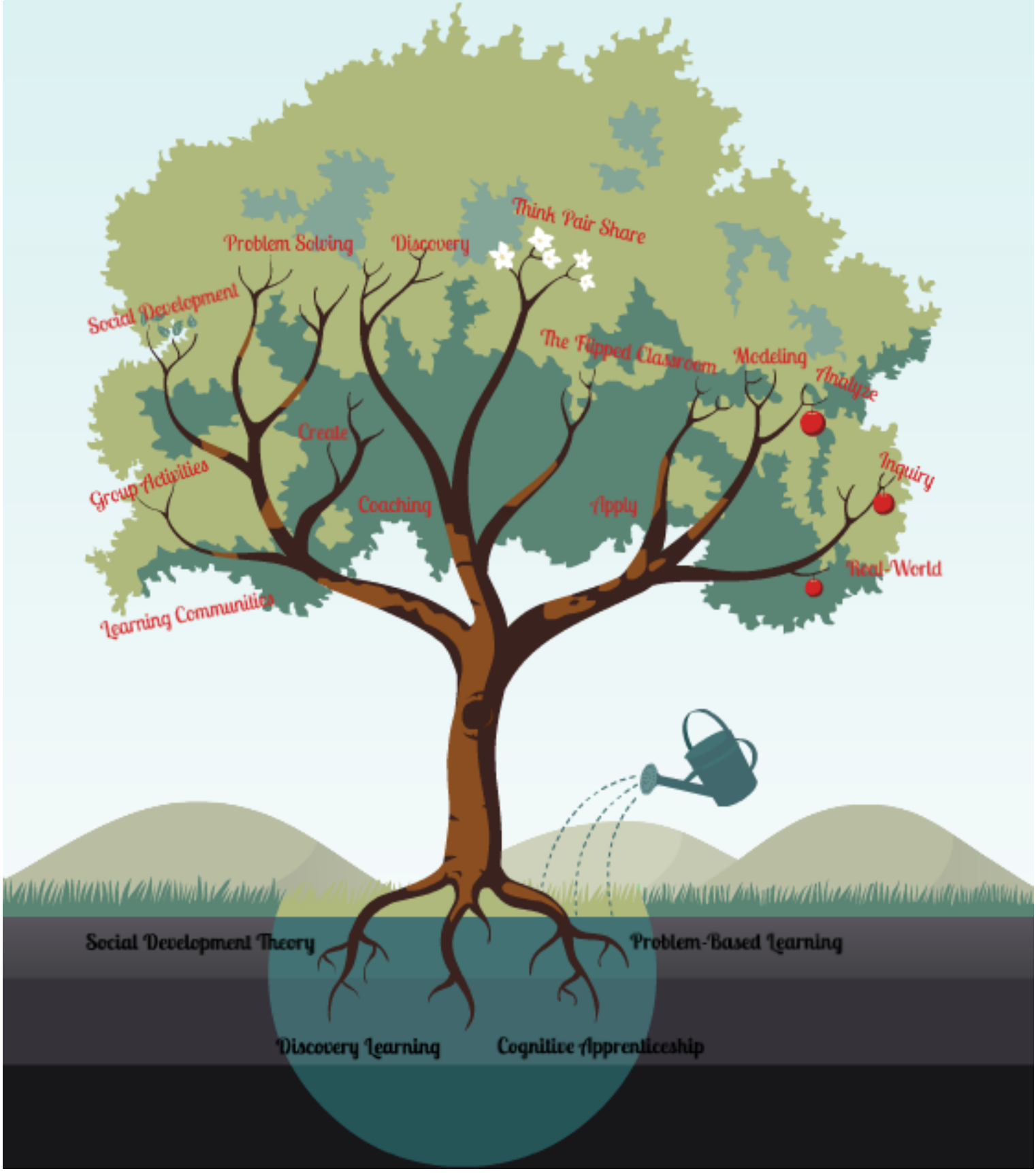
Learning Theories: Practical Applications for Mathematical Classroom



Learning Theories: Practical Applications for Mathematical Classrooms

Social Development Theory

Social Development Theory by Lev Vygotsky argues that the role of social interaction plays a very important role in development. This theory has a strong emphasis on group or partnered learning, where the More Knowledgeable Other (MKO), which could be a teacher, coach or peer (anyone with greater understanding of the subject) works with another the student/group to help their learning. This theory uses the Zone of Proximal Development (ZPD) which is a range between a student completing a task under guidance (teacher or peer) and the student completing the task independently. There is a shift from teacher directed, to student and teacher collaboration in lessons.

This theory is exceptionally useful in the intermediate and senior level. Students at this age are extremely social beings and they will be social in your class whether you let them or not. Therefore, including group activities in your classrooms is very valuable

There are several easy ways to integrate this theory into your classroom practices. One method to use this theory in a mathematics class is to have your students Think, Pair, Share after explaining a concept or example. When presenting a practice problem give students time to work on this with students explaining the solution to the problem to the class – you could displaying the student's work using a document camera. In addition give students time to work on a set of problems and then help them in small groups. Have students take-up a few select problems with assistance of the document camera or SMART Board.

Students retain more and are more engaged when they are working together while the role of the teacher is minimized - increasing the role of the students. Including social interaction in the classroom allows for a much richer and diverse learning experience. Students can share their own experiences and past knowledge allowing for a greater diversity than with solely teacher directed lessons.

Problem-Based Learning

Problem-Based Learning originated at McMaster University is a method of teaching that is rooted in hands-on, real-world activities. Students are given problems or cases in which they work with minimal help from educators – a self-directed approach. PBL allows students to apply their knowledge to a variety of situations and use their resources to determine any other information they need to solve the problem at hand.

Problem-Based Learning (continued)

This theory is useful in the field of mathematics in that it can endorse patient problem solving among students. Students take ownership of their learning since they have a greater responsibility in their own learning process. Students transfer their knowledge to contextual problems – seeing the meaning for mathematical concepts.

Once students have the knowledge of the basic concepts they can then solve Thinking/Inquiry and Application problems. In a math class you can create learning groups and have these groups solve daily problems that are not like any worked-examples shown in class. The groups will have to use their knowledge and resources to solve this problem. This method can be used for summative assignments or ISU projects. Individually or in groups students can be assigned an open ended real-world problem.

Using Problem Based Learning in a mathematics classrooms will help minimize the amount of directed learning, as well as develop student's problem solving skills and critical thinking. This method will help students develop their understanding beyond remembering and understanding, and shift towards application, analyzing, evaluating, and creating – reaching higher levels on the Bloom's Taxonomy of the Knowledge Domain. Through Problem Based Learning students can learn the value of collaboration and communication as well as developing a habit of self-evaluation.

Discovery Learning

Discovery Learning by Jerome Burner is an inquiry based learning theory that allows students to build upon their previous knowledge and draw their own conclusions and relationships. When students draw their own conclusions they create a stronger memory of the problem or process being used. This method helps students take ownership of their own learning.

This is the parent model for Problem Based Learning, and has many of the same advantages and uses. Students work through investigative activities to determine patterns and recognize mathematical rules. For example, you can have your students investigate the occurrence and properties of exponential functions in the natural world. Another way to use discovery learning in mathematic is to give students real-life mathematical word problems. Students can apply their knowledge to solve these problems.

Likewise, you can integrate this theory into the way you develop concepts in your class. Instead of giving students a formula and having them plug in numbers, you can have them determine the outcomes of various situations. Asking questions such as: 'What do you think will happen if I changed this value?', 'How do you think this was developed?', 'Do you think there is an easier way to do this?', 'Will this always work?', 'Are there any other possible solutions?'. Give your students time to think and discuss these questions with their peers.

Discovery Learning (continued)

Using the flipped classroom is another great way to integrate discovery learning into your classroom. Give students a mathematical topic to investigate for the next class. Students will have to determine a definition, real-life examples, and a practice example to bring to the class. Have students use all their resources to determine the information needed to solve the problem. The next day have students work in small groups and explain their findings. These groups can share what they have learned and examples can be taken up as a class.

Discovery learning fosters curiosity, promotes student engagement, and binds memories of the discovery learning event to the concept at hand, developing greater retention and understanding.

Cognitive Apprenticeship

Cognitive Apprenticeship by Collins, Brown and Newman is a method combing six teaching strategies: modeling, coaching, scaffolding, articulation, reflection, and exploration.

To start teachers can write out the steps of concepts and go through a worked example with the class in explicit steps. The next step is to present a problem to the class; they can work on it in small groups which can then be taken-up as a class. Provide students with additional practice problems to work on in support groups while they work– mixed groups of students of different levels, with teacher assistance when needed. When the students return to their seats they can then discuss the process with their elbow buddy or summarize the problem solving steps in a math journal. To help students reflect on the given process/concept you can ask them a series of higher level thinking questions: 'What if this value is changed?', 'Is this the only solution?', 'Is there another way to solve this problem?'. After students have time to process the steps they can apply their knowledge to application and thinking/Inquiry type questions.

Chunking your lessons into different 15 minute activities can allow for the teaching methods in this theory to be followed – modelling problems, guided problem solving, learning communities, reflection and assessment points.